secret Manhattan Project. The growing commitment to internationalism that developed after the war and the benefits to be derived therefrom were the topic of Walter Orr Roberts's 1969 speech advocating more projects such as the Global Atmospheric Research Program.

In addition to Roberts's discussion of the positive things that science could accomplish through international collaboration, Kargon chose for the final section two other addresses that pointed up even more dramatically the alterations that 50 years had made in the way scientists viewed their world and in how society regarded them. That scientists should have more influence, if not actual political power, and that both pure and applied research should expand had been generally accepted as good in the '20's. By 1968 skepticism on both points, with consequent loss of confidence, had affected the scientific community more seriously than society at large.

On the matter of if and how scientists should become active in politics, Don K. Price, dean of the Harvard Graduate School of Public Administration and one of the few social scientists to serve as AAAS president, tried to bring his theoretical insights and his long experience in public service to the aid of his scientist associates currently suffering from the dual shock of intellectual attack and threatened withdrawal of financial support:

> If scientists wish to maintain the freedom of their science and, at the same time, play a rational and effective role in politics, they need to adopt a strategy that is more modest in its hopes for the perfectibility of mankind and more pessimistically alert to the dangers of power—not only power that is obviously political but the power that calls itself private as well. They should start by acknowledging in theory what in the United States we have always taken for granted as a practical matter: that reductionism in scientific knowledge, while it may provide the fundamental advances in scientific theory, does not alone provide the answers in the realm of policy, or the basis for a political ideology.

And finally there is Bentley Glass's keynote speech for the present decade, "Science: Endless Horizons or Golden Age?" to represent the skepticism of the '70's about the hitherto comforting concepts of progress and infinite growth. That the political and the natural scientists both leave us with many provocative questions is at least evidence that the maturity postulated in the book's title is not to be equated with stagnation.

While these speeches amply portray professional idealism in the form in which it still animates older scientists, they do not adequately reflect the latter-day idealism that has produced splinter organizations of scientists dedicated to various forms of political and social action. Whether or not one agrees with specific objectives of these groups (or condones the disruption of AAAS meetings that a few adherents have instigated), the fact that scientists have organized to boycott war research, to finance the election of peace-oriented legislators, or to provide the public with more adequate information is a now well-established phenomenon that should not have been ignored by the spokesmen of science.

To deliver a definitive judgment on Kargon's editorship of this volume would require following his steps through all the 35 annual addresses he did not include. Taking the more positive and less time-consuming course, I will say that in my view here is an unexpectedly readable and highly informative collection of sources that conveys the substance and the spirit of 20th-century science more effectively than any secondhand summary can possibly do and is therefore to be recommended both as a teaching tool and as general reading.

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## Organic Radicals

**Free-Radical Chemistry.** Structure and Mechanism. D. C. NONHEBEL and J. C. WALTON. Cambridge University Press, New York, 1974. xvi, 572 pp., illus. $35.

Free radical reactions are important in organic chemistry, and, worldwide, generate well over a thousand publications a year. As a consequence of this plethora, the secondary literature consists of reviews of specific topics and large, multiauthored compendia, of which Kochi's *Free Radicals* (1973) is the most successful example. Relatively short monographs that sort out the significant principles and present a unified view have been badly needed, and except for those by Walling (1957) and Pryor (1966), such overviews have been notably lacking. This book, intended to "integrate the approaches of the organic and physical chemist in consideration of kinetic and mechanistic aspects of reactions both in solution and the gas phase" and aimed at upper-level students and professional chemists, goes a long way toward filling this need. Its appearance is particularly opportune, since recent advanced texts in physical organic chemistry tend to give radical reactions rather short schrift. (One such text on my desk allows them two pages.)

The authors start with a rather general survey of types of radical reactions, radical-forming processes, and the physical properties and detection of radicals, giving a particularly good discussion of the powers of electron spin resonance spectroscopy and of the geometry and electronic structure of radicals. The balance of the book takes up radical reactions according to class of radical and reaction type. This approach leads to some confusion, since radical displacements and additions, two of the most important reaction types, are discussed chiefly in the chapters on classes of radicals. It's all there somewhere, however, and the reader can locate what he wants in the good topical index. (The book contains no author index.) Particularly good discussions of the reactions of atoms and small alkyl radicals, chiefly in the gas phase, and of homolytic aromatic substitution are presented. There is also a long chapter on radical oxidations and reductions, currently a most exciting topic in free radical research.

The authors make a point of discussing physical chemical principles and generally handle them well. The overall kinetics of chain reactions (in contrast to competitive kinetics) is treated rather cursorily, however. This is an important defect, since overall kinetics defines the conditions for carrying out successful synthetic chain reactions and explains why many superficially plausible processes fail to occur. Radical stability, although discussed at length, is never clearly defined. There are two definitions: one thermodynamic and, with alkyl radicals, usually associated with R–H bond dissociation energies; the other kinetic, and related to reaction rates. The two kinds of stability are obviously related, but it is becoming increasingly evident that highly hindered radicals may be kinetically very stable even though they are thermodynamically stable only in respect to their dimers.

Finally, two reaction classes receive less attention than they deserve: radical reactions on molecular oxygen, which are covered in 19 pages (compared to 53 for homolytic aromatic substitution); and polymerization, which is scarcely

touched on, although the authors note that it is treated in detail elsewhere. Both these reaction classes have enormous technological importance (and most students end up in chemical technology), and the study of them provided many of our present unifying concepts. The roles of energetics, steric hindrance, and polar effects were identified by polymer chemists in the 1940's, as were many of the principles governing radical redox processes. The subsequent development of unifying concepts has been largely the demonstration that many of these principles apply to other systems as well.

In summary, this book fills a need, and I've mentioned what seem to me omissions simply to call readers' attention to matters they may want to look into elsewhere. I hope it will have wide distribution.

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## Rhythmicity

**Biological Clocks in Marine Organisms.** The Control of Physiological and Behavioral Tidal Rhythms. JOHN D. PALMER. Wiley-Interscience, New York, 1974. xii, 174 pp., illus. $12.95.

This attractive little book is a summary of a large quantity of experimental data, together with a certain amount of interpretation, pertaining to biological timing phenomena shown primarily by marine organisms. As the subtitle indicates, the emphasis is on tidal rhythms: cyclic physiological processes which under natural conditions are entrained by tidal factors and which persist, in some cases for many weeks, with a circatidal period under nontidal conditions in the laboratory. The book is generously illustrated, with a clearly drawn figure on nearly every page, and at the end of each of the ten chapters there is a point-by-point summary. This format suggests that the book is intended for use as an accessory text in an undergraduate course, and the author's writing style is also well suited for such an audience: clear, informal, and at times entertaining. Whether the subject matter and its treatment are equally suitable is a moot point.

The book is the outgrowth of a recent lengthy review article by Palmer on tidal rhythms, and that article itself (*Biol. Rev.* [*Camb.*] **48**, 377 [1973]) will probably be the preferred source of information and references for those who are engaged in research on biological clocks. For those who may be teaching a course on the subject, I would emphatically recommend a trip to the library to consult the original literature and decide which of the many phenomena described in Palmer's book are sufficiently well documented to deserve detailed attention in a lecture. Therein lies a central problem in the attempt to understand tidal rhythms.

Some few intertidal species reproducibly show clearly defined, persistent biological rhythms, but the majority of the published literature on so-called lunar-tidal rhythms deals with data in which a rhythm, if present at all, is difficult to discern owing to noise. Elaborate, and often unjustifiable, methods of data analysis have been used to "extract" a presumed periodicity from the data. Such a body of literature should be approached with skepticism. In my opinion, Palmer has done an inadequate job of separating the wheat from the chaff. As just one example, a 1954 study based on data from oysters is given major coverage. That article purports to show that oysters, when transported from the East Coast to a laboratory in Illinois, rephased their tidal rhythms to correspond with times of lunar zenith in Illinois. It was taken by its author, then, as evidence that some factor related to lunar gravity was perceived in the laboratory by the animals. This claim, if substantiated, would represent one of the most exciting sensory phenomena ever to be documented. In discussing these experiments, Palmer voices modest reservations about possible unexplained changes in period of the rhythm. In fact, this 20-year-old study has apparently never been repeated, and there is good reason, based on reanalysis of the data (*J. Theor. Biol.* **8**, 426 [1965]), to suspect that the animals may not have demonstrated a persistent rhythm of any sort, much less a tidally synchronized rhythm that stays in phase with times of local lunar zenith. Many studies of tidal rhythms about which a properly critical reader will have fewer reservations are also described in excellent detail, but the moon-sensitive oysters are by no means the only instance of a questionable report's being given "equal time," often with no critique at all. The coverage of recent English-language publications is little short of exhaustive, and extends, for example, to claims of lunar cycles in human reproduction, another controversial topic that is not treated as such in this book. The one major bibliographic oversight that caught my attention is the omission of Neumann's beautiful and definitive studies on the fortnightly reproduction of the intertidal midge, *Clunio* (see, for example, *Z. Vgl. Physiol.* **53**, 1 [1966]). Neumann is the leading European worker on tidal rhythms, and *Clunio* is one of the few organisms in which a tidally synchronized biological rhythm has been analyzed in sufficient detail to permit strong and fascinating conclusions about the physiological and genetic processes involved.

A book that is as attractively produced as this will have a strong initial appeal. It seems particularly unfortunate to me that the selection of material to be covered was not more judicious. For an illustrated tour through as confusing, controversial, and contradictory a literature as is here involved, the novice needs a more discriminating guidebook.

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## Books Received

**Advances in Biophysics.** Vol. 5, 1973. Masao Kotani, Ed. University of Tokyo Press, Tokyo, and University Park Press, Baltimore, 1973. x, 210 pp., illus. $14.50.

**Advances in the Biosciences.** Vol. 11. Proceedings of a conference, Berlin, Germany, Jan. 1973. Gerhard Raspe and S. Bernhard, Eds. Pergamon, New York, 1974. viii, 248 pp., illus. $18.

**Air Pollution Technology.** Dean E. Painter. Reston Publishing (Prentice-Hall), Reston, Va., 1974. xiv, 284 pp., illus. $13.95.

**Alicyclic Compounds.** W. Parker, Ed. Butterworths, London, and University Park Press, Baltimore, 1973. xii, 318 pp., illus. $24.50. MTP International Review of Science Organic Chemistry Series One, vol. 5.

**Aliphatic Compounds.** N. B. Chapman, Ed. Butterworths, London, and University Park Press, Baltimore, 1973. xii, 374 pp., illus. $24.50. MTP International Review of Science Organic Chemistry Series One, vol. 2.

**ARPA Workshop on Needs of the Department of Defense for Catalysis.** Vol. 2. Proceedings of a workshop, Santa Monica, Calif., Nov. 1973. Leona M. Libby, Ed. R & D Associates, Santa Monica, Calif., 1973 (available from DOD Documentation Center, Alexandria, Va.). vi, 432 pp., illus. Spiral bound.

**Crisis Intervention in the Community.** Richard K. McGee. University Park Press, Baltimore, 1974. xii, 308 pp. $14.50.

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